

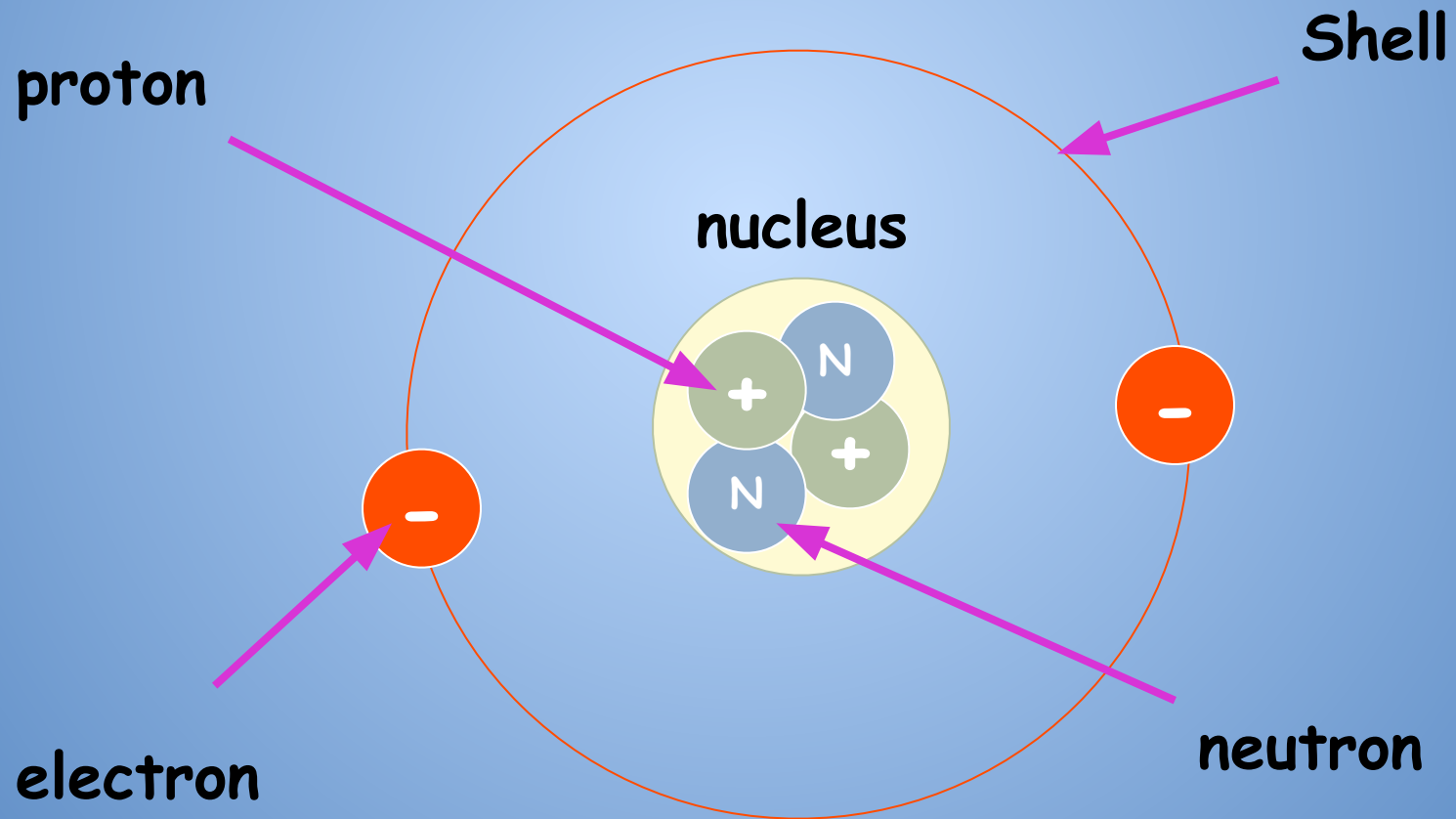
# Atomic Structure & History

DSHS

Physical Science

# The Atom and its History

## I. The Atom



# THE ATOM IS COMPRISED OF:

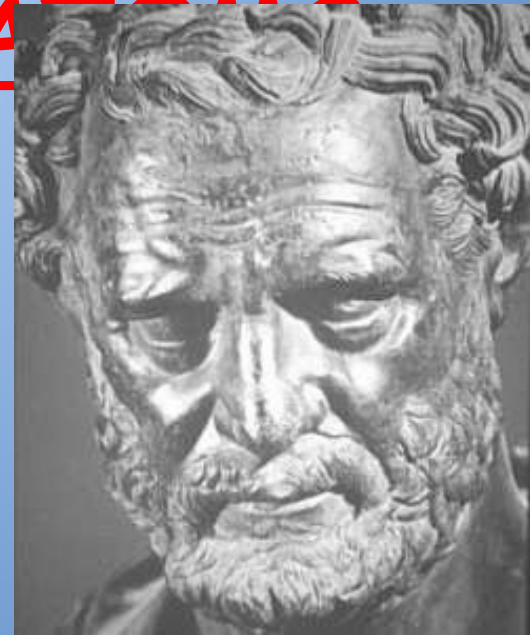
subatomic particle	abbreviated	charge	relative mass	location

# The Atom and its History

## II. Timeline of the Atom

- A. 460 BC Democritus develops idea of atoms
  - 1. he pounded up materials until he reduced them to smaller and smaller particles which he called ATOMS

the word atom comes from the Greek word atomas which means unable to be **cut** or **divided**; indivisible



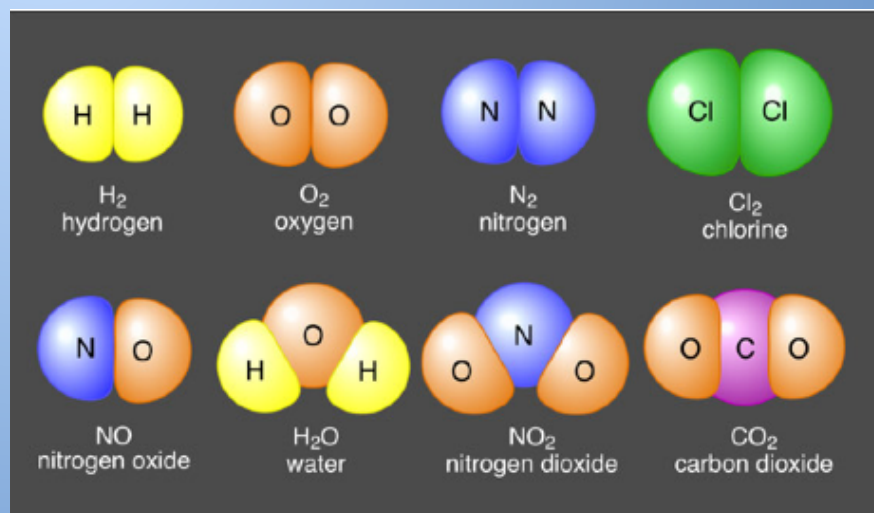
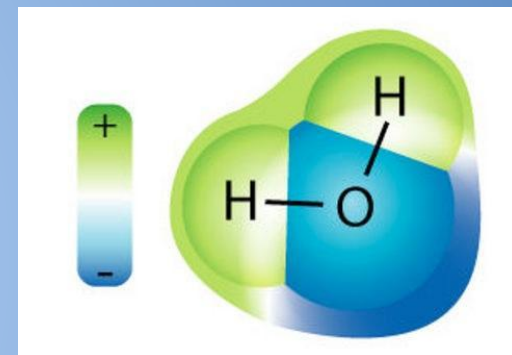
# The Atom and its History

- B. 1808 John Dalton - English school teacher
1. suggested that all matter was made up of tiny spheres that were able to bounce around with perfect elasticity and called them **ATOMS**



# The Atom and its History

- Atoms of a given element are exactly alike
- Atoms of different elements could join to form compounds





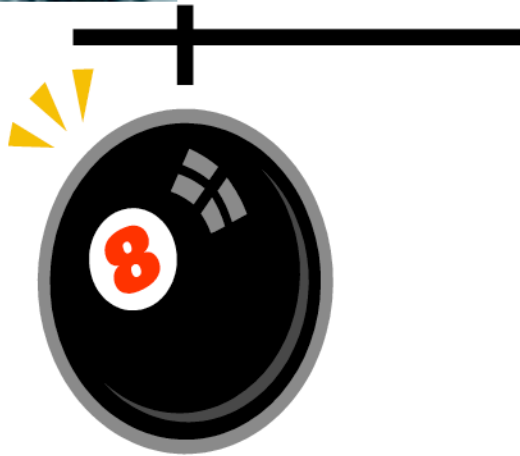
# The Atom and its History

Law of Definite Proportions – chemical compounds always contain the same elements in the exact same proportions by weight or mass



# History of the Atom Timeline

**Democritus 460 BC  
and Dalton 1803 AD**





# The Atom and its History

C. 1898 J. J. Thompson - British scientist

1. found that atoms could sometimes eject a far smaller **negative particle** which he called an

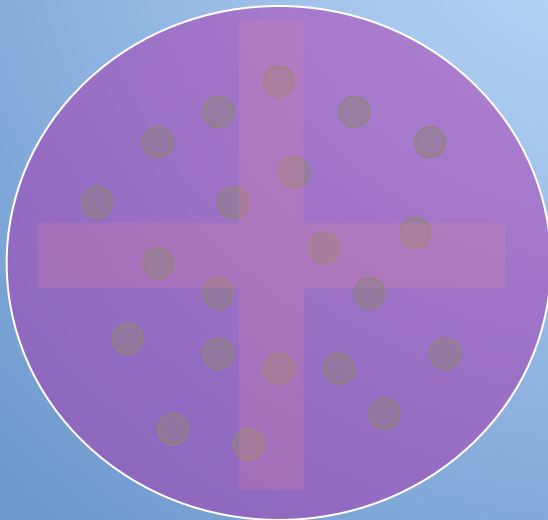
**ELECTRON**



2. His experiment revealed that atoms could be divided into smaller parts

# The Atom and its History

- D. 1904 - Thomson developed the idea that an atom was made up of electrons scattered unevenly within an elastic sphere surrounded by a soup of positive charge to balance the electron's charge like plums surrounded by pudding.



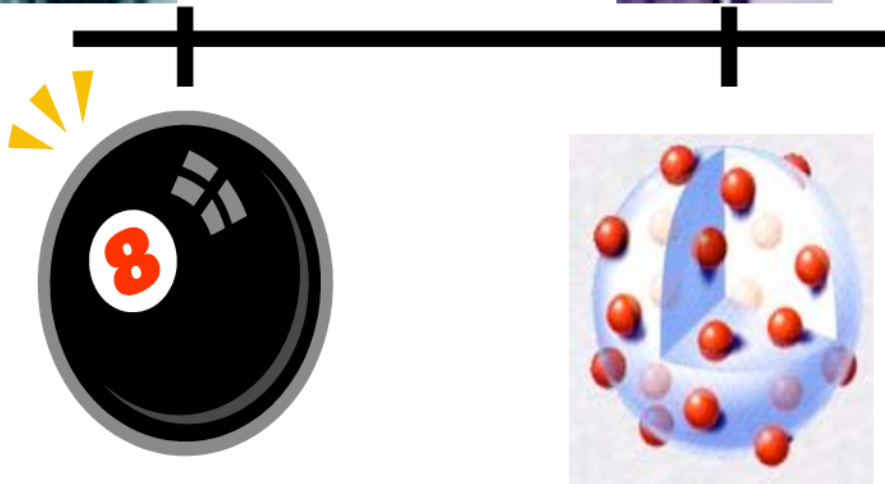
**PLUM PUDDING  
MODEL**

# History of the Atom Timeline

**Democritus 460 BC  
and Dalton 1803 AD**



**Thomson  
1897**



# The Atom and its History

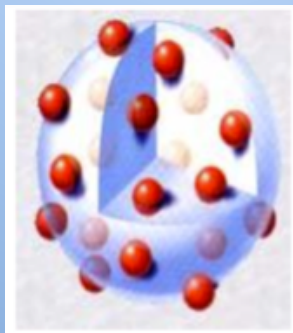
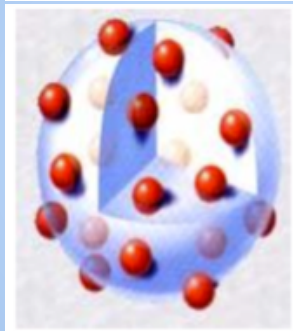
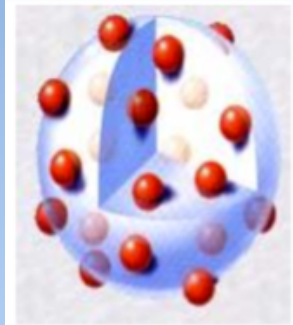
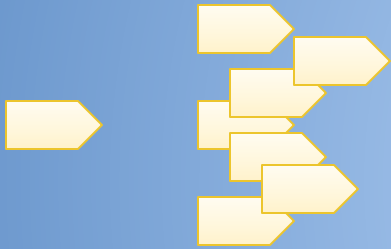
## E. 1910 Ernest Rutherford

1. Tested Thomson's plum pudding model with the: Gold Foil Experiment



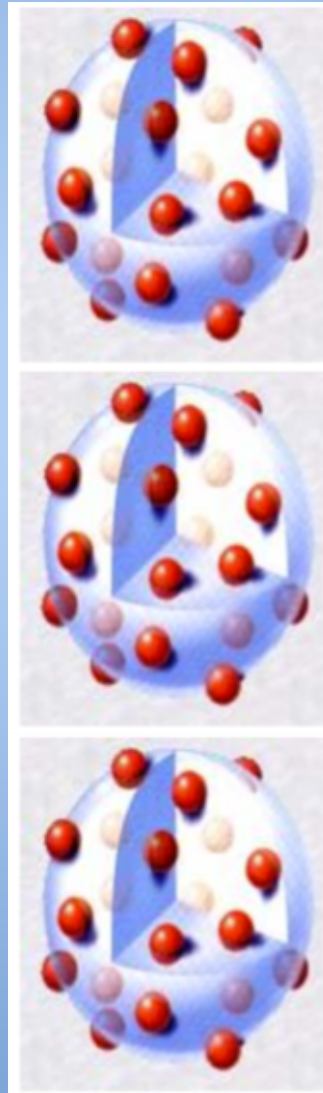
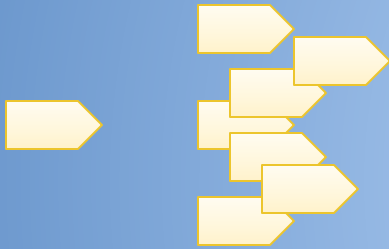
- fired Helium nuclei (alpha particles) at a piece of gold foil which was only a few atoms thick.

# Predicted Results if Thomson's Model is correct



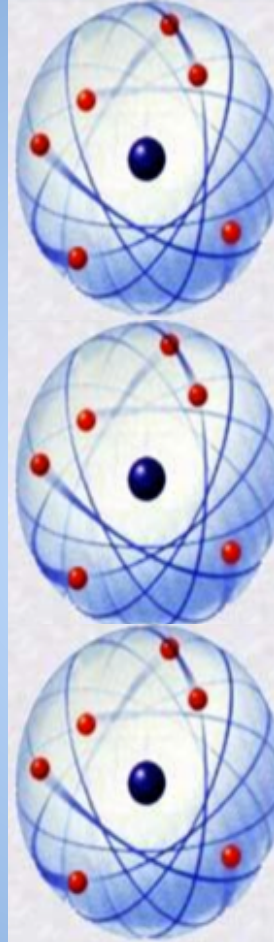
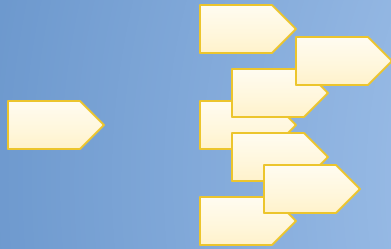
Most go straight through while some get deflected slightly due to positive filling

# Experimental Results of Rutherford's experiment.





# What this means....



Thomson's Plum pudding model was wrong. Instead, there must be something very massive that causes particles to bounce back.

# The Atom and its History

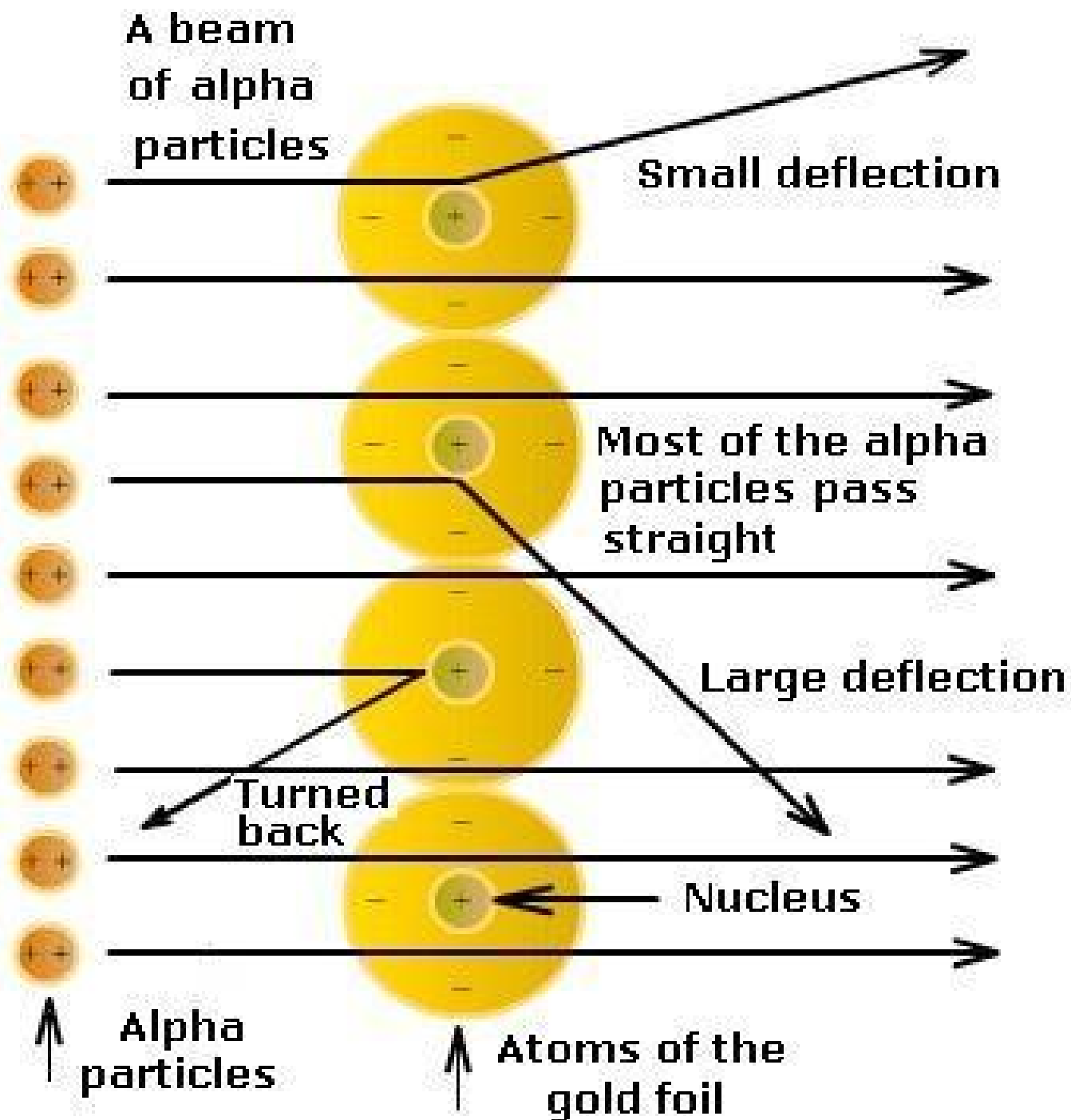
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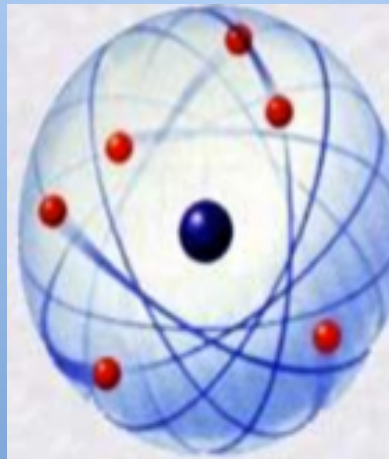
i. found that although most alpha particles passed through foil, about 1 in 10,000 hit and deflected



# Rutherford Experiment: Nuclear Atom

# The Atom and its History

- b. Rutherford's proposed a more detailed model with a **central nucleus**.
  - i. **positive charge** and mass was all in a **central** nucleus.
  - ii. Electrons held in place around the nucleus by **electrical** attraction -- he did not know how the electrons were arranged though



# The Atom and its History

## F. 1913 Niels Bohr - studied under Rutherford

1. Bohr refined Rutherford's idea by adding that the electrons were in **orbits**.
  - a. Like **planets** orbiting the sun.
  - b. Each orbit only able to contain a **set number of electrons**.





# History of the Atom Timeline

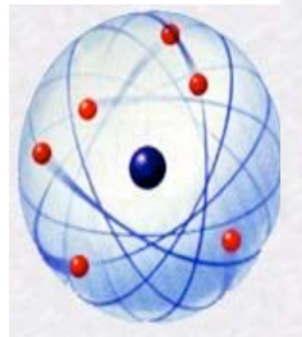
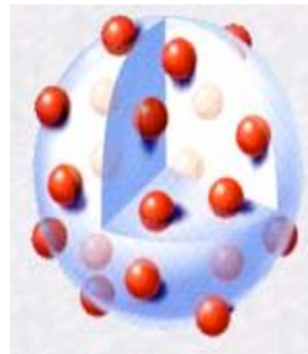
**Democritus 460 BC  
and Dalton 1803 AD**



**Thomson  
1897**



**Rutherford  
1912**



# History of the Atom Timeline

**Democritus 460 BC  
and Dalton 1803 AD**



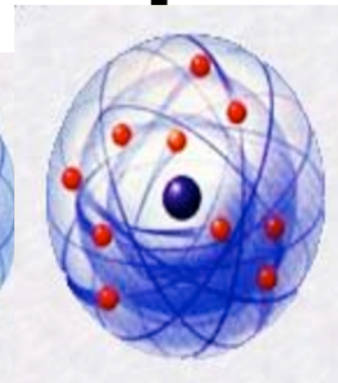
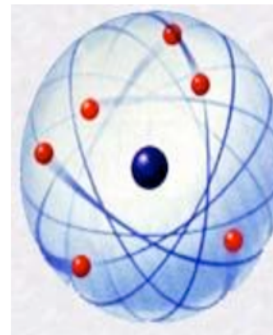
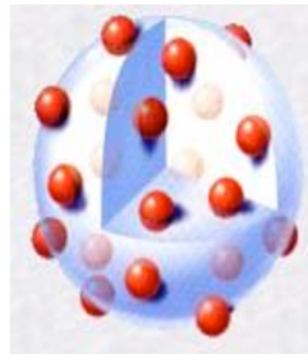
**Thomson  
1897**



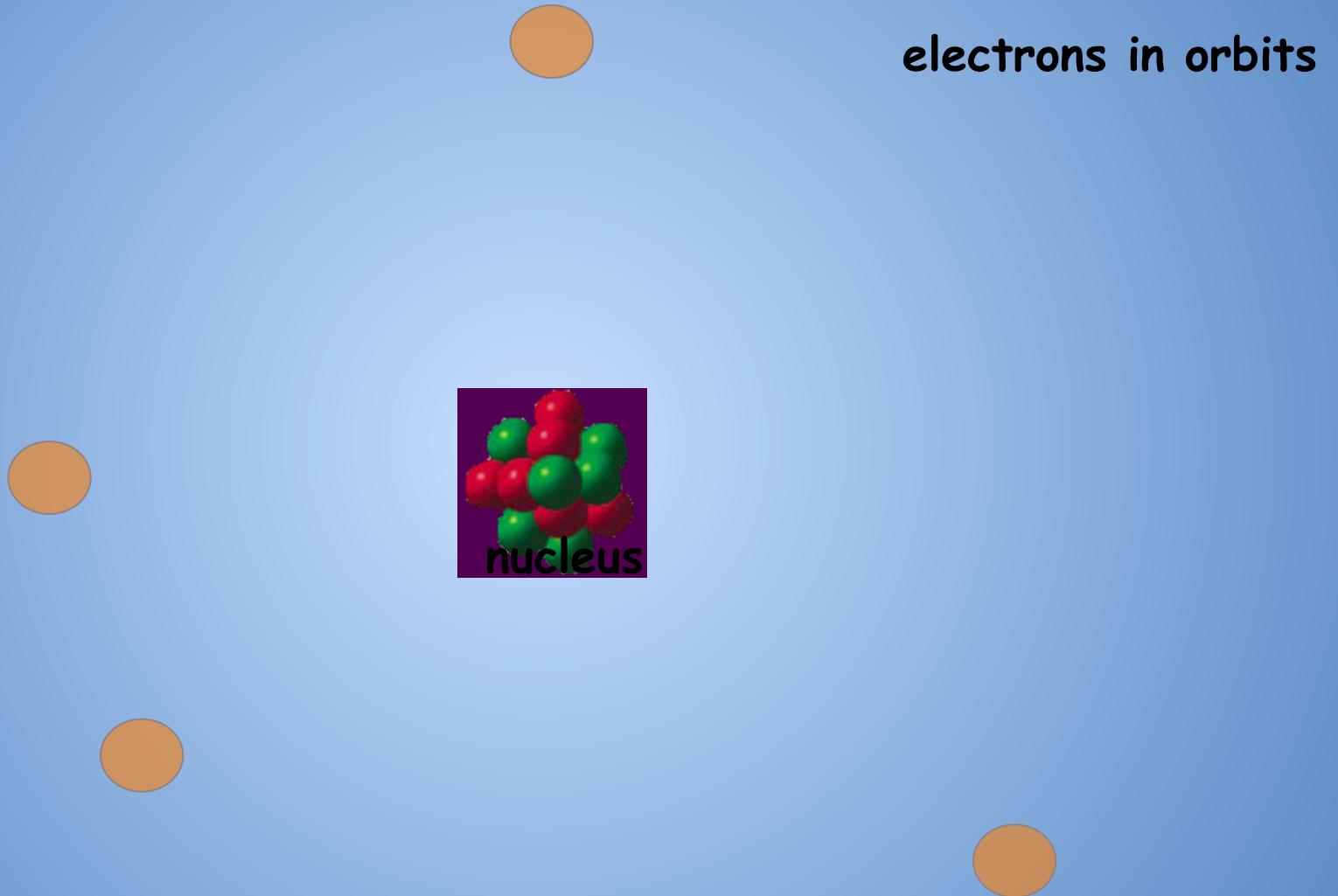
**Rutherford  
1912**



**Bohr  
1913**



# Bohr's Atom



# History of the Atom Timeline

**Democritus 460 BC  
and Dalton 1803 AD**



**Thomson  
1897**



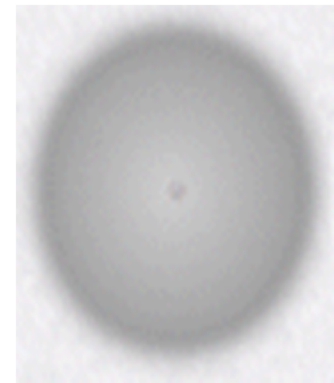
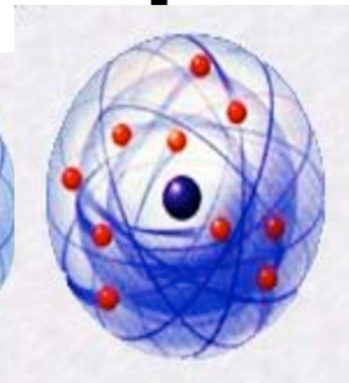
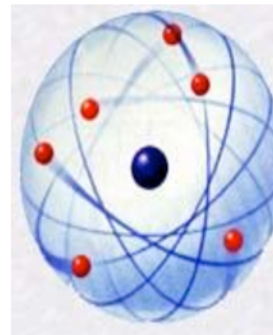
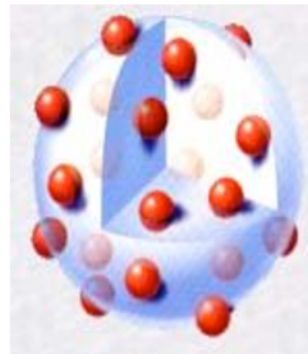
**Rutherford  
1912**



**Bohr  
1913**



**Modern  
Quantum  
Cloud Model  
post 1930**



# The Atom and its History

**B.** Electrons Shells: or Energy Levels determine how electrons are arranged around the nucleus

- first shell      a maximum of **2** electrons
- second shell      a maximum of **8** electrons
- third shell      a maximum of **8** electrons

# Expressing information about an atom using the periodic table

## A. Atomic Shorthand / isotope notation



Atomic mass number

the number of protons and neutrons

Atomic number

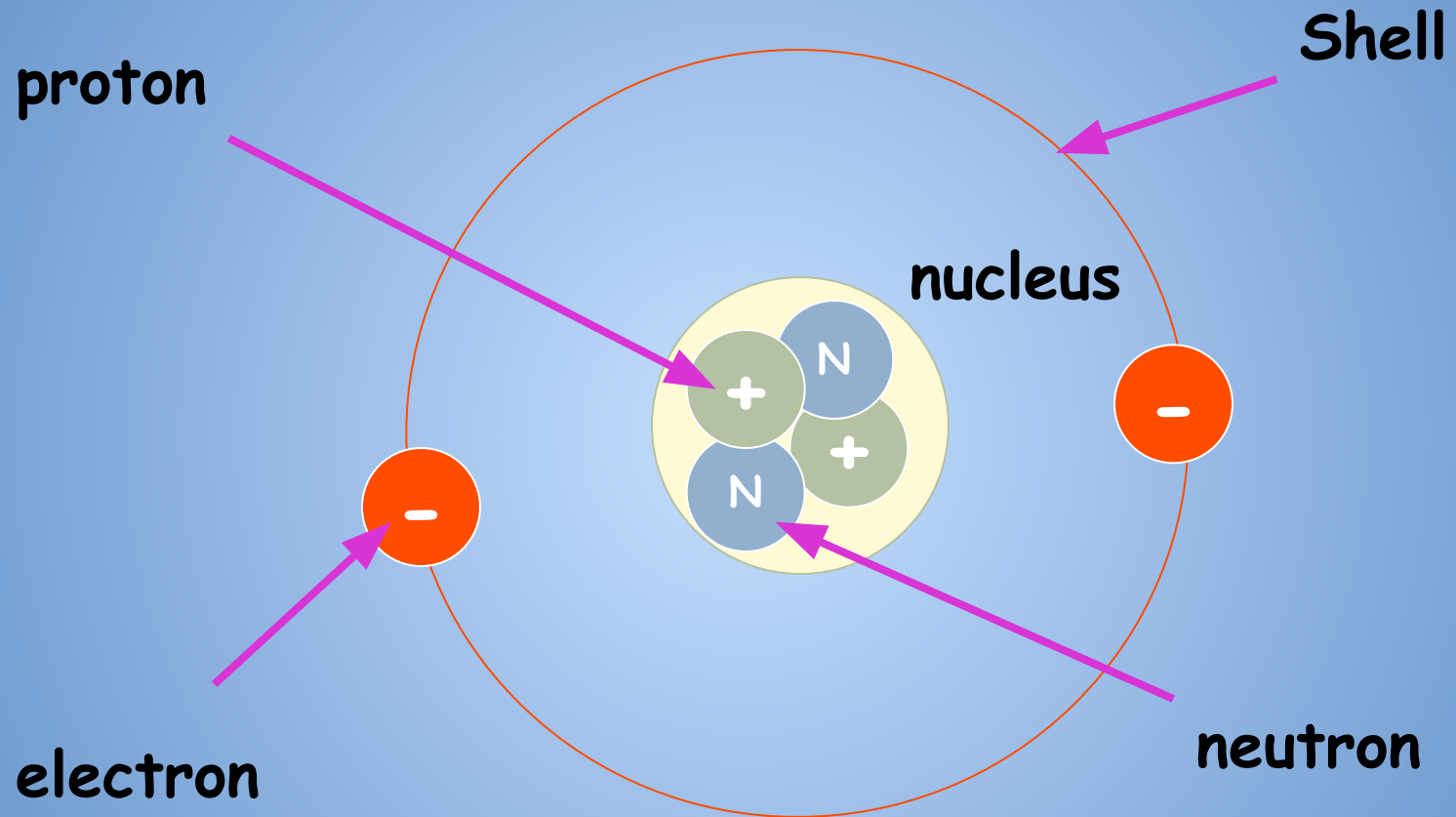
the number of protons

IN A NEUTRAL ATOM

number of electrons = number of protons

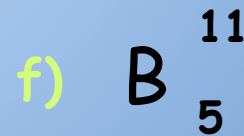
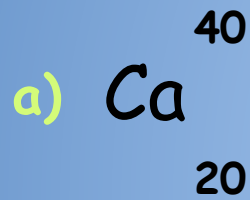


# HELIUM ATOM



# The Atom and its History

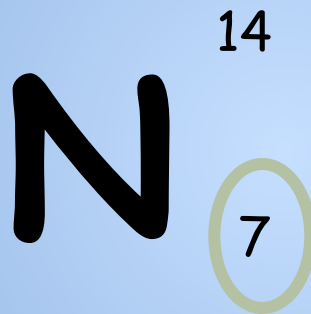
- Determine the number of protons, neutrons and electrons in each neutral atom



# The Atom and its History

1. Electrons fills lower shells before outer shells

Nitrogen



1<sup>st</sup> shell - 2

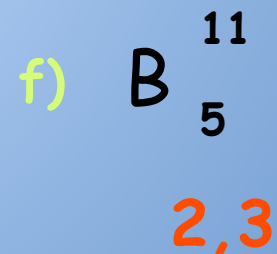
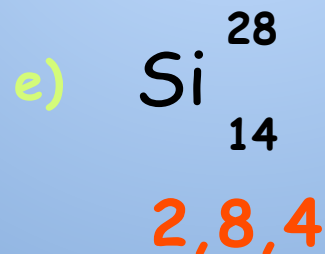
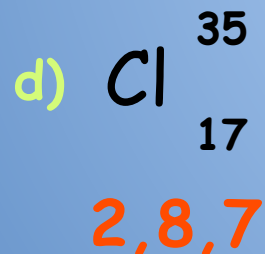
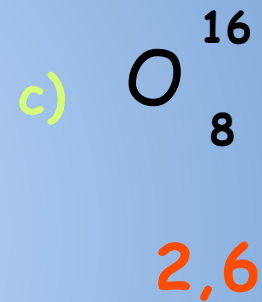
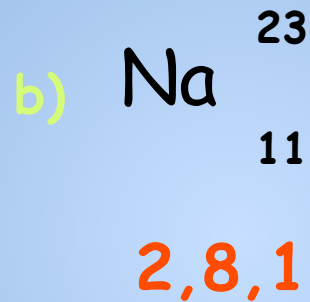
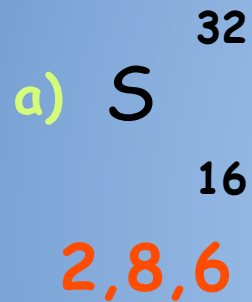
2<sup>nd</sup> shell - 5

3<sup>rd</sup> shell - 0

$$2 + 5 + 0 = 7$$

# The Atom and its History

- Indicate the number of electrons in each shell



# The Atom and its History

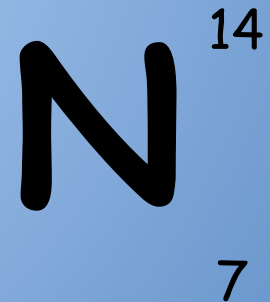
- C. Bohr model shows elements represented by dots to show electrons, and large circles to show the shells. For example;

Nitrogen

1<sup>st</sup> shell - 2

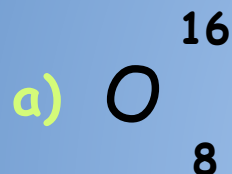
2<sup>nd</sup> shell - 5

3<sup>rd</sup> shell - 0



# Bohr Model & CROSS DIAGRAMS

Draw the Dot & Cross diagrams for the following elements;

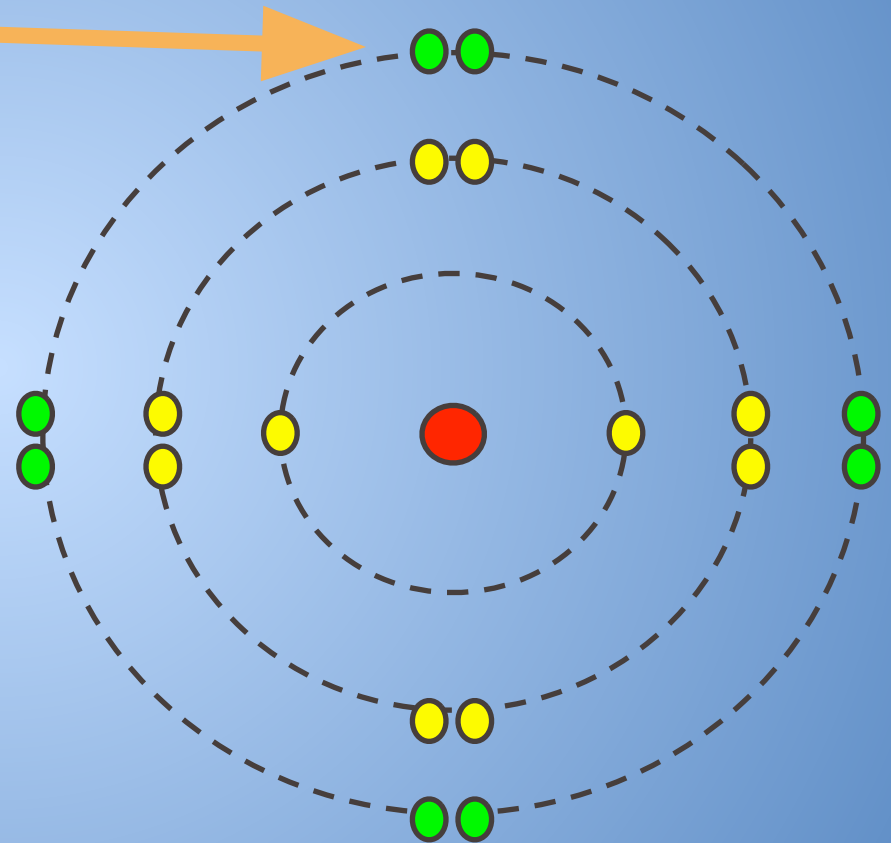




# The Atom and its History

D. Valence Electrons:  
Electrons in the  
outer most shell

1. Determines how  
atoms react with  
other atoms



# Valence Electrons

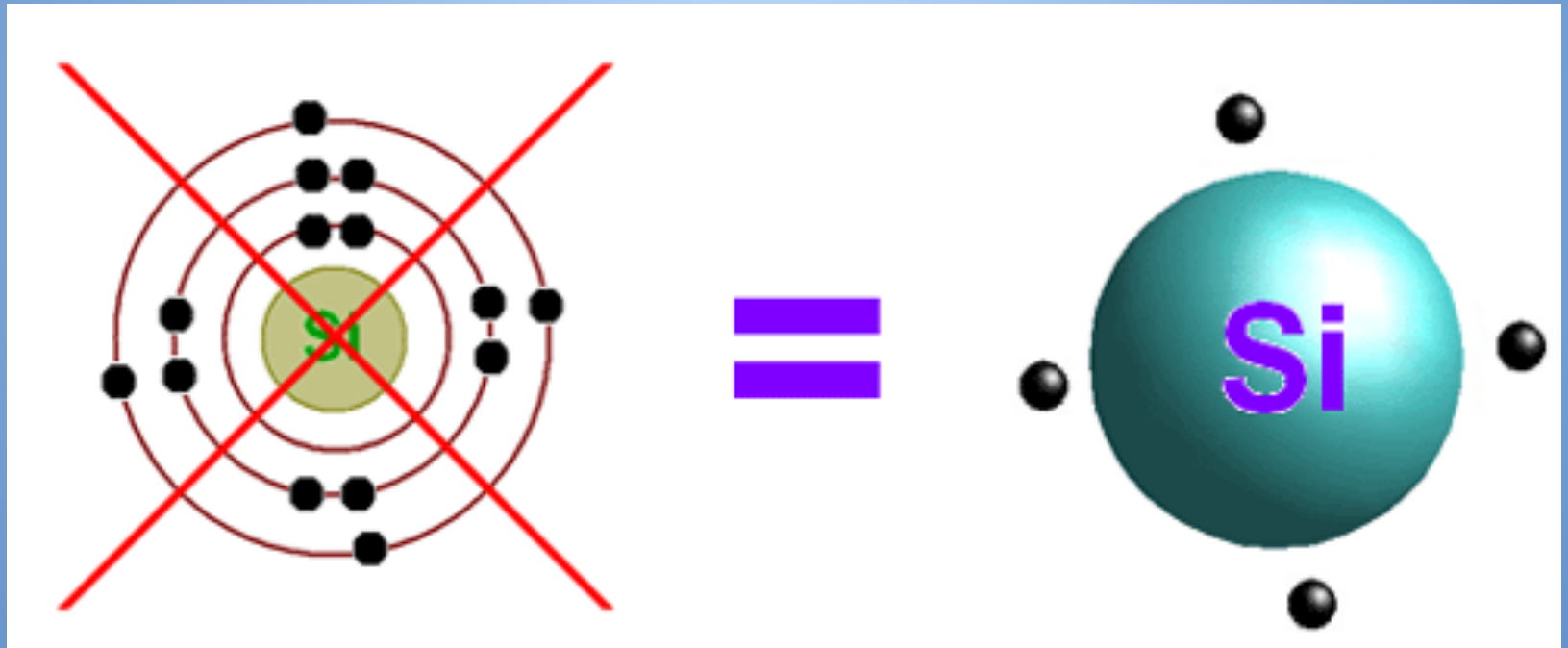
- To find # of Valence electrons count across the top of the periodic table (skipping the transition metals in the "d - block").

1 2 ... 3 4 5 6 7 8

hydrogen 1 <b>H</b> 1.0079											helium 2 <b>He</b> 4.0026
lithium 3 <b>Li</b> 6.941	beryllium 4 <b>Be</b> 9.0122	boron 5 <b>B</b> 10.811	carbon 6 <b>C</b> 12.011	nitrogen 7 <b>N</b> 14.007	oxygen 8 <b>O</b> 15.999	fluorine 9 <b>F</b> 18.998	neon 10 <b>Ne</b> 20.180				
sodium 11 <b>Na</b> 22.990	magnesium 12 <b>Mg</b> 24.305	aluminium 13 <b>Al</b> 26.982	silicon 14 <b>Si</b> 28.086	phosphorus 15 <b>P</b> 30.974	sulfur 16 <b>S</b> 32.065	chlorine 17 <b>Cl</b> 35.453	argon 18 <b>Ar</b> 39.948				
potassium 19 <b>K</b> 39.098	calcium 20 <b>Ca</b> 40.078	gallium 31 <b>Ga</b> 69.723	germanium 32 <b>Ge</b> 72.61	arsenic 33 <b>As</b> 74.922	selenium 34 <b>Se</b> 78.96	bromine 35 <b>Br</b> 79.904	krypton 36 <b>Kr</b> 83.80				
rubidium 37 <b>Rb</b> 85.468	strontium 38 <b>Sr</b> 87.62	indium 49 <b>In</b> 114.82	tin 50 <b>Sn</b> 118.71	antimony 51 <b>Sb</b> 121.76	tellurium 52 <b>Te</b> 127.60	iodine 53 <b>I</b> 126.90	xenon 54 <b>Xe</b> 131.29				
caesium 55 <b>Cs</b> 132.91	barium 56 <b>Ba</b> 137.33	thallium 81 <b>Tl</b> 204.38	lead 82 <b>Pb</b> 207.2	bismuth 83 <b>Bi</b> 208.98	polonium 84 <b>Po</b> [209]	astatine 85 <b>At</b> [210]	radon 86 <b>Rn</b> [222]				
francium 87 <b>Fr</b> [223]	radium 88 <b>Ra</b> [226]	ununquadium 114 <b>Uuq</b> [289]									

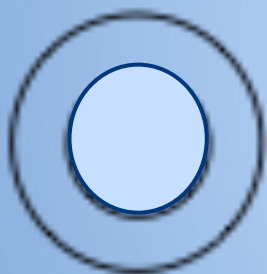
# The Atom and its History

- E. Lewis Dot Model: showing an atom using only the valence electrons.



# The Atom and its History

BOHR MODEL DIAGRAM

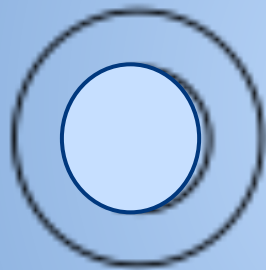


LEWIS DOT STRUCTURE

**H**

# The Atom and its History

BOHR MODEL DIAGRAM

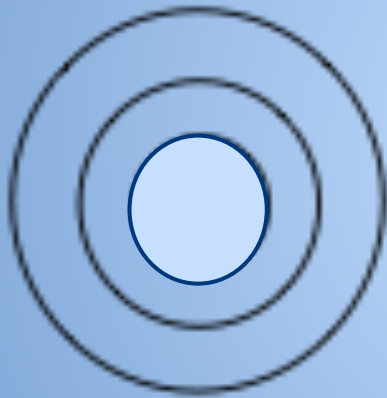


LEWIS DOT STRUCTURE

**He**

# The Atom and its History

BOHR MODEL DIAGRAM



LEWIS DOT STRUCTURE

**B**



# The Atom and its History

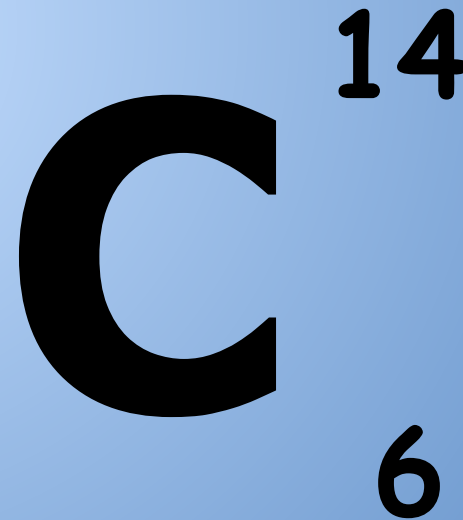
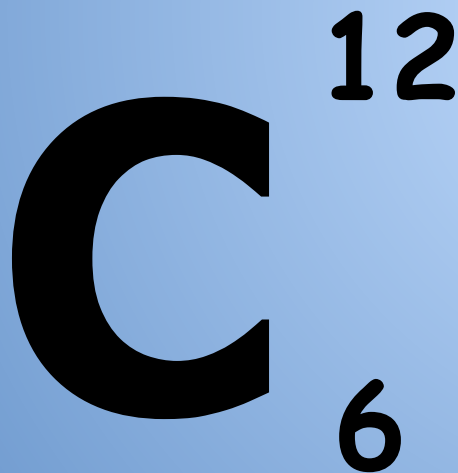
# The Atom and its History

# The Atom and its History

# The Atom and its History

- E. Isotopes: atoms of the same type with the **same** number of protons but **different** number of neutrons.

EX CARBON



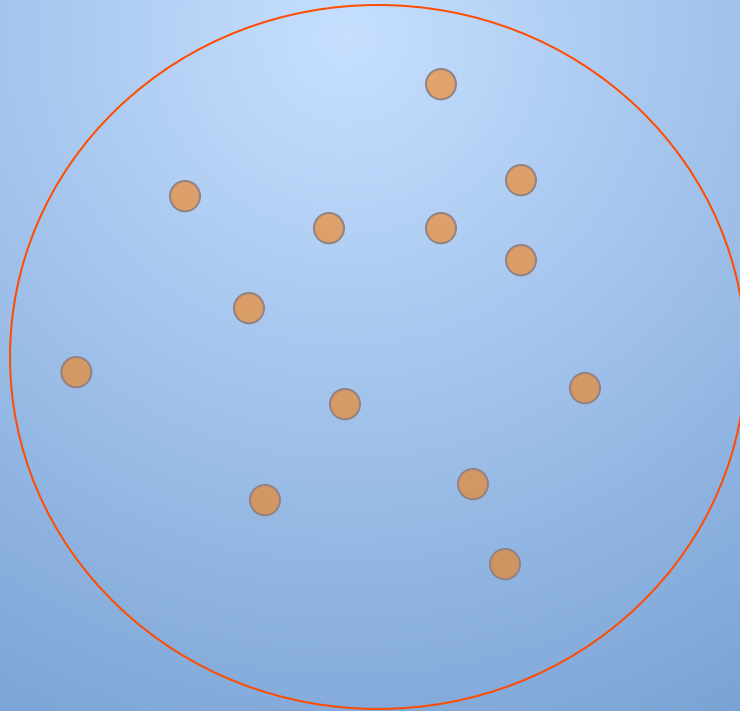
# The Atom and its History

- H. \_\_\_\_\_: Atoms that carry a charge due to the gain or loss of electrons
- The charge of the atom is how many electrons it will give/donate or take /accept from other atoms
- If the charge is + the atom has electrons to donate
- If the charge is - the atom has spaces in its outer shell to be filled

# QUARKS

THE SUB-ATOMIC PARTICLES THAT  
MAKE UP PROTONS AND  
NEUTRONS.

PROTON OR  
NEUTRON



QUARKS



# SUMMARY

1. The **Atomic Number** of an atom = number of protons in the nucleus.
2. The **Atomic Mass** of an atom = number of Protons + Neutrons in the nucleus.
3. The number of Protons = Number of Electrons in a stable atom.
4. Electrons orbit the nucleus in **shells**.
5. Each shell can only carry a **set** number of electrons.

## SUMMARY CONTINUED

6. An **Isotope** is when two elements have the same number protons but have a different number of neutrons.
7. A **Quark** is a sub-atomic particle that makes up Protons and Neutrons
8. **Electrons** are found in the **electron cloud**.